METHOD AND APPARATUS FOR PRODUCTION OF MAGNETIC RECORDING MEDIUM SUBSTRATE

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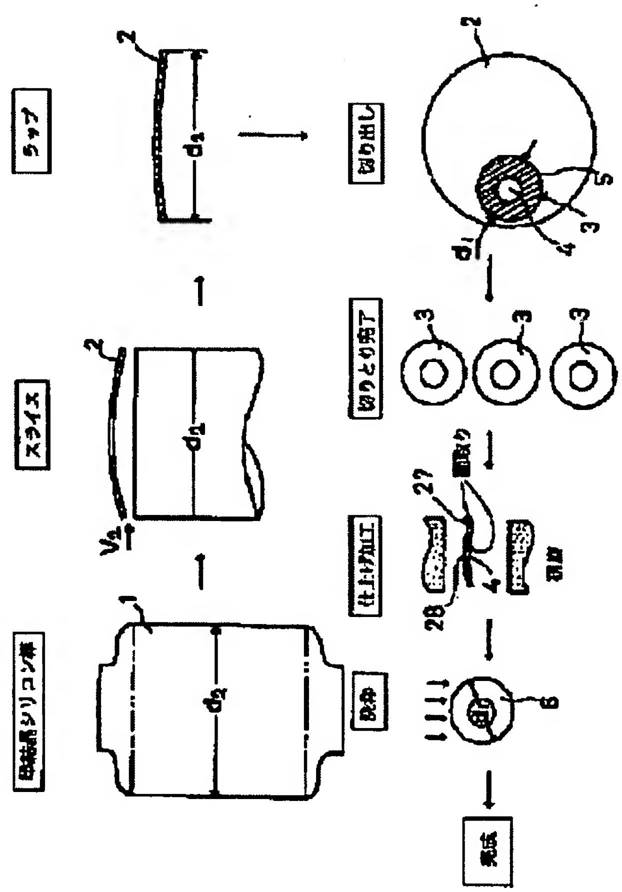
Abstract of **JP6076282**

PURPOSE:To produce the magnetic recording medium substrate, such as substrate for a magnetic disk, which maintains high flatness and concentricity with high efficiency without variations. CONSTITUTION:A wafer 2 is formed by slicing a single crystal silicon rod 1 of a large diameter (diameter d2) at a high speed of a slicing speed V2>V1. Plural sheets of doughnut-shaped disks 3 each having a central hole 4 and a small diameter (diameter d1) are cut out of this wafer and are finished, by which finished products are produced. The cutting out is executed by irradiating the central hole 4 of the cut out disk 3 and edge parts 27, 28 of the outer periphery thereof with a laser beam and rotating the wafer 2 around the central hole 4 at it center. The positioning of the cutting out position of the disk 3 to be cut out is executed by turning the wafer 2 to a prescribed indexing angle position. Where, V1 denotes the sliding speed necessary for generating the warpage of a prescribed value or below from the single crystal silicon rod of the diameter (diameter d1).



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CLAIMS

[Claim(s)]
[Claim 1] The manufacture approach of the magnetic-recording medium substrate characterized by cutting down two or more substrates in the manufacture approach of the substrate made from single crystal silicon used as a magnetic-recording medium substrate (it is hereafter called a substrate for short) from the single-crystal-silicon wafer (it is hereafter called a wafer for short) which has sufficiently larger aperture than the aperture of this substrate.
[Claim 2] the manufacture approach of the magnetic-recording medium substrate according to claim 1 characterized by for the feed hole for revolving-shaft insertion of a substrate and its periphery starting to coincidence along a concentric circle top by the laser beam, and carrying out them.
[Claim 3] The manufacture approach of the magnetic-recording medium substrate according to claim 2 characterized by positioning the irradiating point of said laser beam at the edge of said feed hole of a substrate, and the edge of the periphery, and starting at coincidence to the circumference of the core of the substrate cut down from a wafer while rotating said wafer.
[Claim 4] Diameter d1 of a substrate Sufficiently large diameter d2 The single-crystal-silicon rod which it has is sliced to disc-like. A lap is carried out for the thickness of this disk, and surface adjustment, and it is a diameter d2. After forming a wafer, It is the approach of cutting down two or more substrates, beveling, grinding and washing from this wafer, and manufacturing the substrate of a request configuration. the diameter of small aperture -- d1 it is -- the slice rate which can hold the curvature of the substrate at the time of slicing from a single-crystal-silicon rod below to a predetermined value -- V1 **, when carrying out Said large diameter d2 Slice rate V2 of the single-crystal-silicon rod which it has It is V2 >V1 at least. The manufacture approach of the magnetic-recording medium substrate according to claim 1 to 3 characterized by supposing that it is possible.
[Claim 5] The 1st adsorption base which is a manufacturing installation for cutting down the substrate of small aperture from the wafer of the diameter of macrostomia, is supported free [rotation on a base base], and arranges adsorption opening near the logging location of said wafer, this -- with the 1st motor which carries out the rotation drive of the 1st adsorption base, and the 2nd motor carried on said 1st adsorption base The 2nd adsorption base which is connected with this 2nd motor and comes to arrange adsorption opening at the core of a wafer, The control unit which performs the roll control of said 1st and 2nd motors, and the source of a vacuum connected with said 1st and 2nd adsorption bases, The manufacturing installation of the magnetic-recording medium substrate characterized by preparing the laser beam feeder arranged that the irradiating point of a laser beam should be positioned in the periphery of the substrate cut down, and the edge of a feed hole.
[Claim 6] The manufacturing installation of the magnetic-recording medium substrate according to claim 5 characterized by said laser beam feeder consisting of a laser oscillation machine and a mirror for positioning a laser beam at said irradiating point.
[Claim 7] The manufacturing installation of the magnetic-recording medium substrate according to claim 5 characterized by said laser beam feeder consisting of two or more optical-fiber-transmission modules connected with a laser oscillation machine and it.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the manufacture approach for starting the manufacture approach of a magnetic-recording medium substrate like the substrate for magnetic disks, and equipment, especially manufacturing a highly precise small aperture substrate efficiently from the single-crystal-silicon rod of the diameter of macrostomia, and equipment.
[0002]
[Description of the Prior Art] Although storage capacity and recording density are increasing the magnetic disk which the mass magnetic-recording medium was needed and has played the role central especially as external memory of a computer with progress of an information society every year, development is furthered in order to perform still higher-density record. Especially, it is small and a recording device stron against an impact is desired by development of a notebook sized personal computer or a palmtop personal computer, therefore high density record can be performed more and a powerful magnetic-recording medium of mechanical strength is desired.
[0003] As a substrate for magnetic disks which is this magnetic-recording medium, the thing and glass substrate which carried out NiP plating processing are conventionally adopted as an aluminium alloy and its front face. However, the substrate of an aluminium alloy has abrasion resistance and bad workability, and although it performs NiP plating processing in order to compensate this fault, in what performed this NiP plating processing, it is easy to produce curvature and it has a fault, such as being tinctured with magnetism at the time of high temperature processing. Moreover, a strain layer occurs on a front face at the time of strengthening processing, compressive stress acts, and a glass substra has the trouble of being easy to produce curvature at the time of substrate heating.
[0004]
[Problem(s) to be Solved by the Invention] On the other hand, since the elevated-temperature property of single crystal silicon is good, its thermal expansion coefficient is small, specific gravity is smaller than aluminum and there are many advantages, such as having conductivity, i is the optimal as substrate material.
[0005] Drawing 8 shows the outline of the manufacture approach of substrate 6a. it is shown in drawing -- as -- substrate 6a -- diameter d1 It consists of a disk of the thin meat which has feed-hole 4a for inserting and clamping to a revolving shaft at the core. In order to manufacture this substrate 6a, it is a diameter d1 first. The single-crystal-silicon rod 29 is made. Next, drilling processing which punches the through tube 3 equivalent to feed-hole 4a is performed. Slice processing of the single-crystal-silicon rod 29 which punched the through tube 30 is carried out at predetermined thickness. After beveling processing of the disk 3a of the shape of a doughnut by which slice processing was carried out is carried out by a grinding stone (****) etc. in the edge of feed-hole 4a and a periphery, the lap on the rear face of front and finishing polish are performed. Substrate 6a is completed by washing that an abrasive material etc. should finally be removed.
[0006] However, since processing etc. is performed per cylinder substrate of small aperture by the above-mentioned approach, as shown in drawing 9 , the value of the curvature of a substrate and its variation are large. In addition, drawing 9 displays the value (micrometer) of curvature on an axis of abscissa, and displays the frequency on an axis of ordinate. It is required to, form feed-hole 4a and a periphery in a concentric circular disk on the other hand, if it is in substrate 6a. That is, although substrate 6a inserts a revolving shaft in feed-hole 4a and it rotates, if there is eccentricity in feed-hole 4a and a periphery, the bias of a center of gravity will arise and rotation of substrate 6a will become unstable.
[0007] in order [moreover,] to increase storage capacity -- a magnetic disk -- when the concentricity of substrate inner circumference and a periphery is bad, it becomes a ** rule in the place where the distance of the inner circumference of a substrate and a periphery is the shortest, and it becomes impossible to use an outside more than it, although he wants to record to a periphery if possible since [however,] feed-hole 4a is punched in the state of the single-crystal-silicon rod 29 by the conventional manufacture approach shown in drawing 8 -- a hole knee -- bein generated -- easy -- and a hole -- it becomes uneven [the cutting force at the time of processing], and it becomes difficult to hold highly precise concentricity.
[0008] Moreover, in a magnetic disk drive, in order to stabilize a magnetic disk on that front face and to perform super-contiguity or migratio of the magnetic head at the time of writing or read-out although it contacts, the magnetic head is arranged and writing of the information on th magnetic head and read-out are performed in this condition on it, the curvature of a substrate is so good that it is small. However, if it slices from the single-crystal-silicon rod 29, curvature arises and the amount of curvatures is proportional to a slice rate mostly. This curvature is har to be corrected by polish of a back process, the lap, etc. Then, slice rate V1 which generates only the amount of curvatures with which it may be satisfied of desired flatness in a slice process It is necessary to slice. On the other hand, in the case of the conventional technique shown in drawing 8 , the outer diameter of the single-crystal-silicon rod 29 is the diameter d1 of a substrate. Since it corresponds, it is necessary to slice by necessary number of sheets. Therefore, it is difficult for the number of cases of slice processing to increase and to plan a productivity drive also in a next processing process.
[0009] This invention tends to solve the above-mentioned point and the purpose is in offering the approach that the substrate excellent in little flatness and concentricity of curvature for magnetic-recording media can be manufactured with sufficient productive efficiency, and equipmen

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[0010]
[Means for Solving the Problem] That is, the manufacture approach of the substrate of this invention according to claim 1 is characterized by cutting down two or more substrates in the manufacture approach of the substrate made from single crystal silicon from the single-crystal-silicon wafer which has sufficiently larger aperture than the aperture of this substrate.
[0011] The manufacture approach of the substrate of this invention according to claim 2 is characterized by the feed hole for revolving-shaft insertion of a substrate and its periphery being started by coincidence along a concentric circle top by the laser beam.
[0012] The manufacture approach of the substrate of this invention according to claim 3 is characterized by positioning the irradiating point of said laser beam at the edge of said feed hole of a substrate, and the edge of the periphery, and starting at coincidence while it rotates said wafer to the circumference of the core of the substrate cut down from a wafer.
[0013] The manufacture approach of the substrate of this invention according to claim 4 Diameter d1 of a substrate Sufficiently large diameter d2 The single-crystal-silicon rod which it has is sliced to disc-like. A lap is carried out for the thickness of this disk, and surface adjustment, and it is a diameter d2. After forming a wafer, It is the approach of cutting down two or more substrates, beveling, grinding and washing from this wafer, and manufacturing the substrate of a request configuration. the diameter of small aperture -- d1 it is -- the slice rate which can hold the curvature of the substrate at the time of slicing from a single-crystal-silicon rod below to a predetermined value -- V1 **, when carrying out Said large diameter d2 Slice rate V2 of the single-crystal-silicon rod which it has It is V2 >V1 at least. It is characterized by supposing that it is possible.
[0014] The manufacturing installation of the substrate of this invention according to claim 5 The 1st adsorption base which is a manufacturing installation for cutting down the substrate of small aperture from the wafer of the diameter of macrostomia, is supported free [rotation on a base base], and arranges adsorption opening near the logging location of said wafer, this -- with the 1st motor which carries out the rotation drive of the 1st adsorption base, and the 2nd motor carried on said 1st adsorption base The 2nd adsorption base which is connected with this 2nd motor and comes to arrange adsorption opening at the core of a wafer, It is characterized by preparing the laser beam feeder arranged that the irradiating point of a laser beam should be positioned in the control unit which performs the roll control of said 1st and 2nd motors, the source of a vacuum connected with said 1st and 2nd adsorption bases, and the periphery of the substrate cut down and the edge of a feed hole.
[0015] As for the manufacturing installation of the substrate of this invention according to claim 6, said laser beam feeder is characterized by consisting of a laser oscillation machine and a mirror for positioning a laser beam at said irradiating point.
[0016] The manufacturing installation of the substrate of this invention according to claim 7 is characterized by said laser beam feeder consisting of two or more optical-fiber-transmission modules connected with a laser oscillation machine and it.
[0017]
[Function] The single-crystal-silicon rod of the diameter of macrostomia (d2) to slice rate V2 A wafer (diameter d2) is sliced and a lap is carried out in the condition. Therefore, the effectiveness of lap processing improves as compared with the case where the lap of the substrate (large number) after cutting down a small aperture substrate is carried out. Furthermore, since two or more substrates (d1) of small aperture are cut down along with a concentric circle by the laser beam from the above-mentioned wafer, it is efficient and a substrate with high concentricity can be manufactured. In addition, even if the curvature of a wafer is large, since a substrate is cut down from some wafers, it is held in desired flatness. That is, the slice rate of a wafer can be made quick in the range which can make the amount of curvatures of the substrate by which logging manufacture is carried out below a predetermined value, and productive efficiency can be improved. It is the slice rate V2 of a wafer at least as one standard. V1 It becomes possible to enlarge and a part activity rate with a large slice rate can be gathered for a slice process.
[0018]
[Example] Hereafter, one example of this invention is explained based on a drawing. Drawing 1 is an explanatory view explaining the production process of this example, and drawing 2 is the flow chart of the production process of this example. Drawing 3 is a sectional view explaining the amount of curvatures of the substrate by this example, and drawing 4 is a diagram for explaining the effectiveness of this example. Drawing 5 is the block diagram showing one example of the manufacturing installation which the manufacture approach of this example carries out, drawing 6 is a top view for explaining the logging activity of the substrate by said manufacturing installation, and drawing 7 is a flow chart for explaining the logging activity by the manufacturing installation of drawing 6 .
[0019] First, drawing 1 and drawing 2 explain the manufacture approach of this example. Diameter d2 The diameter single-crystal-silicon rod of macrostomia is manufactured (step 100). Slice rate V2 explained later A slice is performed and a wafer 2 (diameter d2) is formed (step 101). Next, in order to prepare the thickness and the front face of a wafer 2, an abrasive grain is used and a lap is performed (step 102). Next, the doughnut-like disk 3 (it abbreviates to a diameter d1 and a following disk) is cut down from a wafer 2 by the laser beam from the laser beam feeder explained later (step 103). Logging processes a feed hole 4 and a periphery 5 into coincidence along a concentric circle top, and performs them. Of the above, the disk 3 of two or more sheets is formed. Next, beveling by the feed hole 4 of a disk 3 and the grinding stone of a periphery 5 is performed (step 104). Polish processing on the rear face of front of a disk 3 is performed succeedingly (step 105), and the substrate 6 of desired flatness is done. Next, the abrasive material which adhered to the substrate at the washing process is removed, and manufacture of a substrate (step 106) 6 is completed (step 107).
[0020] It is the amount of curvatures according [on drawing 3 and] to the slice of a wafer 2 (diameter d2) delta 2 When it carries out, it is the amount delta 1 of curvatures of a disk 3 (diameter d1). delta 2 It becomes a far small value. The amount delta 2 of curvatures Slice rate V2 which slices the single-crystal-silicon rod 1 If it becomes large, it will be equivalent to it and will become large. It is the small aperture d1 like the production process of the conventional technique which showed the disk 3 temporarily to drawing 8 on the other hand. When it slices from the single-crystal-silicon rod 1, it is the amount delta 1 of curvatures in the amount of curvatures of desired value. Slice rate V1 for holding It is decided. Diameter d2 A wafer 2 to diameter d1 When a disk is cut down, it is the amount delta 1 of curvatures. delta 2 Rate V2 when slicing a wafer 2 from the part single-crystal-silicon rod, since it is made to a far small value The above-mentioned slice rate V1 It turns out that it can enlarge. Time amount of a slice can be short-****(ed) by the above. Furthermore, since lap processing is carried out in the condition with a wafer 2 in step 102, the productivity of a lap process improves and stabilization of quality is obtained. While the value of curvature becomes low and flatness of drawing 4 improves compared with the conventional technique which shows dispersion in the flatness (micrometer) of the substrate 6 manufactured by the process of drawing 1 and drawing 2 , and was shown in drawing 7 , it turns out that dispersion decreases.

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[0021] Drawing 5 shows the manufacturing installation 7 for logging of the disk 3 in the production process of the above mentioned substrate 6. The outline configuration of the manufacturing installation 7 is carried out from the source of vacuum 13 grade which connects the 1st adsorption base 8, the 1st motor 9 for the rotation drive, the 2nd adsorption base 10, the 2nd motor 11 for the rotation drive, and the 1st and 2nd motors 9 and 11 with the control unit 12 which performs drive control, and the 1st and 2nd adsorption bases 8 and 10. The 1st adsorption base 8 consists of a cylinder object which has the flange 16 which installs inside the vacuum path 15 connected with the source 13 of a vacuum while forming the adsorption opening 14 in the location which carries out phase opposite with the feed hole 4 of the disk 3 of the small aperture started from a wafer 2, and a flange 16 is supported free [rotation] through bearing 18 on the base base 17. The 1st motor 9 is connected with the 2nd adsorption base 10 while it is laid on the base base 17.
[0022] On the other hand, the 2nd motor 11 is laid on the flange 16 of the 1st adsorption base 8, is connected with the 2nd adsorption base 10, and supports it. The 2nd adsorption base 10 is the core O2 of the wafer 2 carried on it. While forming the adsorption opening 19 in the location which carries out phase opposite, the vacuum path 20 which is open for free passage in the source 13 of a vacuum is installed inside. In addition, the revolving-shaft core of the 2nd motor 11 is the core O2 of a wafer 2. It is in agreement.
[0023] A control unit 12 is connected with a power source 21 while connecting it with the 1st and 2nd motors 9 and 11. A control unit is constituted by ON of the 1st and 2nd motors 9 and 11, and OFF so that arbitration indexing control of the 2nd motor 11 may be performed, while it carries out drive control. Moreover, the control valve of **** is interposed between the source 13 of a vacuum, the 1st and the vacuum path 15 of the 2nd adsorption base 8 and 10, and 20, and ON of a free passage with the source 13 of a vacuum and OFF are performed.
[0024] In this example, it has structure of the laser beam feeder 22 to the laser oscillation machine 23 from a half mirror 24 and reflective mirror 25 grade. In addition, the laser oscillation machine 23 is well-known. It reflects by the half mirror 24 and the laser beam 26 from the laser oscillation machine 23 is irradiated by the edge 27 of the periphery 5 of the disk 3 cut down. moreover, the laser beam 26 which passed the half mirror 24 -- the reflective mirror 25 -- reflecting -- the edge 28 of a feed hole 4 -- an irradiating point -- floodlighting -- it is arranged like. In addition, it is the core O1 of a feed hole 4 in the condition of having been positioned so that a laser beam 26 could floodlight at said irradiating point. It is arranged so that the revolving-shaft core of the 1st motor 9 may be in agreement.
[0025] Next, the flow chart of drawing 5 R> 5, drawing 6 , and drawing 7 explains the operation of a manufacturing installation 7 shown in drawing 5 . first, the wafer 2 by which the lap was sliced and carried out from the single-crystal-silicon rod 1 of the diameter of macrostomia of drawing 1 (d2) -- the 2nd adsorption base 10 top -- carrying -- the core O2 about [the core of the adsorption opening 19 of the 2nd adsorption base 10, and] -- it attaches so that I may do one. The 2nd vacuum path 20 and source 13 of a vacuum of the adsorption base 10 are made to open for free passage in this condition, and a wafer 2 is adsorbed on the 2nd adsorption base 10 (step 200). core O1 of the feed hole 4 of the disk 3 which carries out include-angle indexing positioning of the location which a control unit 12 should carry out the rotation drive of the 2nd motor 11, and should cut down and carry out a disk 3 (step 201), starts, and is carried out The location used as the adsorption opening 14 of the 1st adsorption base 8 about 1 law is decided on (step 202). While intercepting a free passage with the 2nd adsorption base 10 and the source 13 of a vacuum (step 203), the 1st vacuum path 15 and source 13 of a vacuum of the adsorption base 8 are made to open for free passage here. In addition, as described above in this condition, they are the revolving-shaft core of the 1st motor 9, and the core O1 of a feed hole 4. It is in agreement and the irradiating point of the laser beam 26 irradiated is in agreement with the edge 27 of the periphery 5 of a disk 3, and the edge 28 of a feed hole 4 (step 204). Next, the rotation drive of the 1st motor 9 is carried out. Thereby, as shown in drawing 6 , a wafer 2 is the core O1 of a feed hole 4. It rotates by making it a core (step 205). as carried out, since [said] it is fixed to edges 27 and 28, the irradiating point of a laser beam 26 starts a feed hole 4 and the periphery 5 of a disk 3 by the laser beam 26 to coincidence along a concentric circle top, and is carried out (step 206). Next, adsorption of the cut-down disk 3 with the 1st adsorption base 8 is canceled, and a disk 3 is taken out with the ejection means of **** (step 207). Again, a wafer 2 is adsorbed with the 2nd adsorption base 10, and it returns to step 201 that the location which cuts down and carries out the following disk 3 should be positioned above the 1st adsorption base 8. The cut-down disk 3 is sent to the process [degree] side of the finish-machining process shown in drawing 1 (step 208). The disk 3 of two or more sheets can be cut down and manufactured one by one by repeating the same actuation and performing it hereafter.
[0026] As an example of an experiment, it is referred to as diameter d1 =48mm of a disk 3, and is referred to as diameter d2 =150mm of a wafer 2, and thickness to slice is set to 0.635mm. In this case, the disk 3 of about six sheets can be cut down and carried out. Moreover, it is a slice rate in the case of suppressing curvature to 3 micrometers, when manufacturing a diameter d1 =48mm single-crystal-silicon rod with the conventional technique, slicing it and making a disk 3 V1 It carries out. When curvature manufactures the disk 3 3 micrometers or less by this example, even if there are about 30 micrometers of curvatures of a wafer 2, the 3-micrometer disk 3 can be cut down and created.
[0027] The explanation of the above of logging by the manufacturing installation 7 of this example is for clarifying structure of this equipment in fact, first, the irradiating point location of a laser beam 26 is decided correctly beforehand, and the disk 3 with good concentricity is manufactured by making the irradiating point location of a laser beam 26 carry out outline coincidence of the logging location of the disk 3 to a wafer 2, and performing said logging operation.
[0028] The manufacturing installation 7 shown in drawing 5 does not show the outline of equipment structure, and is not limited to the content of this example about the detail structure of equipment. As a laser beam, it is CO2. Although laser is used, of course, it does not restrict to it. Moreover, of course, it does not matter even if it uses the optical-fiber-transmission module which carried out two or more (this example 2) connection of the optical fiber of **** as a laser beam feeder for example, not only for the thing of this example but for a laser oscillation machine. Thereby, positioning of the irradiating point of a laser beam can be ensured [simply and].
[0029]
[Effect of the Invention] In the approach of claim 1, since two or more substrates are cut down from the wafer of sufficiently bigger aperture than the aperture of a magnetic-recording medium substrate and the becoming substrate, though the wafer before starting has big curvature, the curvature of the substrate after starting becomes small. Moreover, since it can treat as one substrate until it starts, the productivity of the slice from a single-crystal-silicon rod and both the processes of a lap improves. in the approach of claim 2, since the feed hole for revolving-shaft insertion of the substrate of small aperture and its periphery start to coincidence along a concentric circle top by the laser beam, and are carried out, the concentricity of the feed hole immediately after logging and a periphery is good, there are little the beveling cost and etching cost after logging, and it ends and the complicatedness of the activity of a centering is lost, productivity improves. In the approach of claim 3, in order to position the irradiating point of a laser beam at the edge of the feed hole of the substrate of small aperture, and the edge of the periphery and to

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carry out coincidence logging, logging can carry out with high precision easily only by rotating the wafer which has sufficiently larger aperture than the aperture of this substrate to the circumference of the core of the substrate of small aperture. the approach of claim 4 -- setting -- small aperture d1 the slice rate which can hold the curvature of the substrate sliced from the single-crystal-silicon rod below to a predetermined value -- V1 ** -- diameter d2 large when it carries out Slice rate V2 of the single-crystal-silicon rod which it has Since it comes to make V2 >V1 possible at least, the activity rate of a slice process can be gathered. In the equipment of claim 5, a laser beam is positioned at a feed hole and the edge of a periphery, and since equipment is constituted so that it may start by making it rotate centering on a wafer and a feed hole, a substrate with good concentricity can be manufactured. In the equipment of claim 6, since a laser beam feeder consists of a laser oscillation machine and a mirror for positioning a laser beam at an irradiating point and it consists of two or more optical-fiber-transmission modules by which a laser beam feeder is connected with a laser oscillation machine and it in the equipment of claim 7, highly precise logging both becomes possible by control of optical system.

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